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# **ESTABLISHING AN EFFECTIVE WORLD WIDE WEB: A GOVERNMENT AGENCY PERSPECTIVE**

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## INTRODUCTION

In recent years, laws passed by the United States Congress have mandated that federal agencies both reduce their paperwork and make information publicly available. The Paperwork Reduction Act of 1995 and the Electronic Freedom of Information Act of 1996 are two examples of such legislation that emphasize a decrease in the amount of red tape involved in the process and an increase in the ease of which government information can be disseminated to the general public.

With the amount of information that the government generates and maintains, each federal agency has a monumental task to accomplish. However, technology has provided a means of simplifying, if not solving this dilemma. The Internet, a global network of networks and computers, provides a physical path for disseminating the information world-wide. Information system software developed within the last decade, specifically the World Wide Web (WWW), provides a vehicle for information to travel that path.

When an organization is establishing its WWW information service, an approach must be set to specify goals and the plans to achieve these goals far in advance of any information service being made available.

A trial and error approach will severely diminish the service's effectiveness and may do irreparable damage to its potential usefulness. The only situation that could be worse for an organization than not having a WWW information service is to have one that is cumbersome (or even useless) in discovering information, poorly structured, frustrating to navigate, and/or containing invalid information.

This report will discuss critical issues of the design and implementation of a government agency's World Wide Web information service. Although the perspective of this report is from that of a government agency establishing an information service to make its own information available to the public, the guidelines are still applicable to private entities, educational institutions, and any other non-governmental organizations.

## HISTORY

The Internet, a network of networks linking computers around the world has always had a great unexploited potential since its inception during the 1960s. The communications system network was used by the military during the Cold War era as a means of assuring reliable communication to various computer nodes if any of the nodes were to be lost from the network. The project was originally funded by the Advanced Research Project Agency (ARPA) and was therefore given the name ARPAnet. The ARPAnet was the original network that is known today as the Internet.

Shortly after the military had started the network project, research institutes and universities began to get their computer systems connected to this new network. This allowed researchers who were geographically separated to share data and collaborate on experiments. But even as the Internet was no longer exclusively the military's domain, there was still a great amount of complexity in using the Internet and the software needed to navigate it and to retrieve information from various computer systems that were connected to the network.

As more organizations began to network their computers together and connect them to the Internet, the amount of information on the Internet greatly increased. Traditional software programs, that were used simply for transferring information as files, such as FTP (File Transfer Protocol) addressed only information retrieval issues and not information discovery. With so much information on so many computers in so many locations becoming available, the problem was no longer how to get the information, but where to find the information? This dilemma led to software being developed for new information systems and tools that addressed both retrieving and discovering information. Some of the more popular and recent information systems are Gopher, Wide Area Information Servers (WAIS), Veronica, Archie, and the World Wide Web.

Although many information systems have been developed over the last decade, none have had near the magnitude of effect that the World Wide Web (WWW) has had on how people discover and retrieve information. The main reason for the popularity of the WWW is its design for displaying information.

The WWW allows the usage of multimedia (graphics, text, audio, and video) information. This allows much of the complexity of the Internet to be abstracted away from users. Users are presented with information in a easy and familiar manner; as if they were viewing “pages in a book”.

Organizations, including military, government, academic, and commercial have all scrambled to establish their own WWW servers to provide their information to users. The WWW’s popularity has also drawn millions of people online; onto the Internet to use the Web as a tool for getting information that may otherwise be unavailable to them. The last couple of years have seen multitudes of new WWW software coming on to the market. WWW software development is focussed not only on WWW servers and clients, which are used for providing and navigating web sites, but also information generation software. This second class of software allows the information to be generated in the WWW’s native language, HyperText Markup Language (HTML). There has also been a movement of commercial software vendors retrofitting or releasing a new version of their products to have some sort of WWW capability incorporated. Through all of this, the end result has been that more and more information is becoming available.

## **INFORMATION SYSTEMS**

When an organization makes the decision to establish its own WWW information system, it must first go into a design phase instead of jumping right to the implementation of the service. Design plans for the implementation of the system today, as well as plans for tomorrow, must be considered. Pre-planning will help ensure the information service as being a success. Although no matter how well conceived, plans cannot be made to encompass every possible circumstance that may arise in the future of the WWW information service. Thorough design planning will eliminate many potential problems and allow for the flexibility to meet unforeseen circumstances down the road.

It is important to give the design phase as much attention as, if not more than, the implementation phase. Lack of attention to design and hasty implementation will provide an organization with the only

consequence worse than not having a WWW service. That is having an information service that is poorly designed and implemented, which leads to the WWW service being cumbersome, or worse yet useless, in discovering information, poorly structured, frustrating for users to navigate through, and/or containing inaccurate information.

## **Goals**

Although different federal agencies may set different secondary goals for their WWW information service, the primary goal should be the same. The primary goal is for the information to be easily navigated and disseminated. It is important that secondary goals do not conflict with the primary goal.

If a secondary goal does conflict with the primary goal then perhaps that subgoal should be rethought and altered or even eliminated so that the overall goal of providing the information is not diluted.

## **Approach**

In achieving the primary and secondary goals set for the information system, it is necessary to have a planned out approach. The approach that should be taken should be structured and have resolutions available for any problems that may arise during the actual implementation of the system. A set of standard guidelines should be established. Guidelines need to be structured enough, so that the WWW will also have a structure, and be flexible enough, so as to encompass particular situations that may arise which were not planned for in any significant amount of detail. Striking the middle ground between the two extremes, having no structure and being too rigidly structured, is key to achieving the information service's maximum effectiveness.

## **WWW DESIGN**

Prior to implementing the WWW information service, it must be designed. The design phase is critical to the potential effectiveness of the service. The design must make decisions on basic components of the information service like the hardware and software to be utilized and the personnel who will perform



various assigned tasks as part of the information service. The design process must also address the issue of setting policy for the information service. In other words, setting rules or guidelines for the implementation and maintenance of the WWW. Each of these design considerations will be discussed in more detail in the remainder of this section.

## **Hardware**

The task is to establish an appropriate hardware suite on which to host the WWW information service.

There are several considerations that are important to hardware design and selection. These considerations include speed of processing requests for information, network traffic isolation, and security.

The hardware platform selected for a server should be a dedicated machine. Dedicated being defined as not having user accounts on the system that do not pertain to system or web administration. Any unnecessary loading of the server hardware, with users performing tasks loading the processor, will only hamper the speed of which the server can reply to a request for information. The bottom line is that users will lose patience during long delays in servicing their requests for information. A user will abort out of a request if it is not responded to in an expeditious manner and search elsewhere for the information. This will reduce the information service's effectiveness.

As the information service grows in popularity, it will also begin to generate more network traffic as bytes of information flow to and from the server as it receives and responds to requests over the Internet.

Isolation to its own subnetwork will separate traffic to the organization's other system from that specifically for the information service. This will also help increase speed of response to requests for information.

Another good reason to isolate the WWW information service to its own subnetwork is security. The WWW service will most likely be the highest profile computer system for an organization and therefore likely to attract, and be more susceptible to, attacks from external sources. Network isolation will keep any potential attacks on the system contained and removed from other systems. It will also be easier to monitor the service for potential attacks.

## ***Software***

There are many options for the WWW software needed to execute the information service. The main program is known as the server software. The server software is the code that actually monitors the network for incoming requests, processes the requests, and sends an outgoing response back to the client. The server software is necessary. There cannot be an information service without it. The software needed may be available for free if it is in the public domain. It most certainly will be available for a price when either purchased commercially or as shareware. While public domain software may be comparable to a commercial package, the level of customer support more than likely won't be. Consider this during the process of weighing costs and features when selecting the server software.

Additionally, there is a multitude of layered WWW software available. Layered software is not necessary to running an information service but it can greatly enhance the capabilities of the service. A few examples of these layered programs are log file analyzers and search engines.

The software used to host a WWW service is constantly evolving. The different vendors are always leapfrogging one another in adding new features that makes their software more desirable. The best choice may vary depending on different organization's different requirements set by the system's design. When selecting the software for the WWW service, keep in mind the proposed design of the system. Will it need encryption for secure transactions? Are there additional security requirements? What kind of loading is anticipated? What types of information are necessary to log to files? Will there be a requirement from the system to make extensive use of databases? Then compare the software packages to determine which ones best meet the requirements.

## ***Assigned Roles***

An often trivialized part of the design is the designation of roles for personnel who will participate in the creation, operation, and maintenance of the information system. Although these assignments may seem

insignificant, they really are important to the information service for maintaining structure and cohesiveness. The last situation there needs to be is a duplication of effort or disjoint efforts that are in conflict with one another. Assigned personnel should not only know their own role but the role of others who they may need to work with to get their own job done. The roles for personnel involved with WWW service fall into four basic categories and are described in the following sections.

## System Administrator

All computer systems should have a system administrator and the system the WWW information service is hosted on is no different. The main responsibility of the system administrator is to ensure the hardware and software that composes the server suite is operational and meets required performance levels. This encompasses the processor, disk drives, additional peripherals, network, and operating system software including everything except the WWW software. The WWW software is usually beyond the scope of the system administrator's responsibilities. This is because a system allocated for the information service is going to create a highly and widely visible system for an organization. This, in turn, mandates a significantly higher level of administration than systems with fewer users and smaller scopes.

However, it may be the case that a system administrator's duties encompass the WWW software. This is especially true for a dedicated network and system configuration for the WWW service. However, a system administrator may be responsible for several networks and computers and may not be able to provide the required time to the WWW service. For this case, it is important to differentiate between a system administrator and a "web administrator".

## Web Administrator

The web administrator, or "webmaster" as he or she is sometimes referred to, is responsible for everything related to the WWW service within the computer system. The web administrator is responsible for the operation of the WWW service processes, the logging files, the information files and the file system they reside within, and any additional layered software that may also be used in support of the WWW.

The web administrator may end up doing a bit of everything when it comes to the WWW service. Tasks like log file archiving and analysis, software development and testing, information creation and conversion of traditional formats of information to web formats (HTML), information link testing, adding of new information and removing of outdated information. The web administrator must also work with the system administrator to ensure that any problems with the hardware or operating system are resolved and that the system achieves a maximum up-time state.

The tasks that are related to the WWW software should be performed by the web administrator. The tasks that are more concerned with the information service's contents, generation, and policing can be delegated to a body of individuals involved with the organization's WWW that will be collectively known as the "web team".

## Web Team

An organization's web team is composed of any members who will have an active role in providing a part of the information content of the WWW service. The web team could be composed of many members. Only in the smallest of organizations could a few or even a single individual be responsible for capturing the organization's information and getting it placed into the WWW service. Team members may or may not actually perform the task of generating information in WWW formats; that is to create HyperText Markup Language (HTML) documents. They may however tag information that flows through the organization's natural channels as information to be inputted to the WWW service. The larger the organization, the larger the information space and the more frequent are disjoint pools of information. It is essential to position web team members at various key points in the information space of the organization. This will aid in the entire organization's information being well represented within the service. Essentially, web team members are responsible for capturing information in the organization for the WWW and for aiding non-team personnel who have information to be incorporated into the WWW.

## **Web Board**

Now that roles have been designated to make sure the WWW system, its hardware, and operating system will be online, maintained and filled with captured organizational information, there must be roles assigned to personnel who will determine what the content of information will be. This role should be assigned to a group of individuals with representation from the organization's planning office. This "web board" is tasked with shaping the future direction of the information service and verifying the information content being inputted is in coordination with this desired direction. The web board must also manage the various efforts of information being put into the system to make sure it is balanced. If one part of the information service is severely lacking, then the board must redirect effort to fill in any information "holes" so the information service will not give the impression that any missing information may be less important. By deciding and making sure that the "web policy" and direction of the information service are followed, the web board guarantees that the WWW service reflects the organization in the light that it was intended.

## ***Web Policy***

The most crucial part of establishing an information service, and probably the least thought about, is to incorporate a set of rules governing how the information service is built and maintained. This "web policy" should address issues as to how information gets from someone's desk or computer into the WWW service, how information gets approved for release, when and who periodically reviews the information for accuracy and currency, and how information eventually gets removed from the WWW service. It should also detail how information is structured and formatted so that it "fits" in with the rest of the information to give the service a seamless appearance.

Although a web policy may at first seem like excessive bureaucracy, it is invaluable to the overall effectiveness of the information service. Policies will make information being placed within the information service more structured and consistent. This will allow users to quickly access the

information that they are seeking, which is the primary goal of the WWW information service. It will also save an agency from being embarrassed from information that is outdated or completely inaccurate by having offices or personnel assume responsibility for every piece of information that goes into the service. Unfortunately, if an agency chooses to save time and effort and operate without a well thought out policy, or no policy at all, the work expended with duplication of effort and correcting problems in the future will be far more costly.

A reasonable approach to setting web policy would be to form a working group of select individuals who have some experience in dealing with the organization's information flow and individuals who may have knowledge of, or experiences with, information services.

## **WWW IMPLEMENTATION**

There are an infinite number of ways to design and implement a WWW information service. Of course, no two will be exactly alike. There are, however, some common tips or rules that will make an organization's WWW more effective. At first, these suggestions may seem to be little more than common sense. But, it is the overlooking of the smaller details, like the misspelling of words, that can unfavorably sway the user's perception of the organization's WWW information service and most importantly of the organization itself. The following guides are some of the lessons learned from a large sampling of WWW information services that have become successful and effective. These practices are always good to keep in mind when implementing a WWW information service.

### ***Structure***

If the information service doesn't have a structure to it that is simple, cohesive, and consistent then it will inhibit users from finding the information that they are searching for within it. Even if the WWW information service is physically hosted on multiple machines, the structure should make the user feel as if they were on one logical machine; one information service. No one will spend hours browsing through an agency's web site trying to find a piece of information. Information must be made readily available.

Otherwise, users will take their searches elsewhere. This could possibly sour a user from returning to the WWW information service in the future for information. There are many techniques that can help to successfully structure the WWW information service.

**Navigation** - Navigation through the levels or sections of information in the system must be consistent. The model for navigation should not change within the service. For instance, If the up arrow means go *up* one level of information in the structure in one section of the WWW, it shouldn't mean go *back* to the home page in another section. Navigation should be consistent to get to equivalent levels in different parts of the WWW information service. Select a model that is simple and adhere to it throughout the service.

**Naming Conventions** - Just as organization's World Wide Web hosts have a convention of being named 'www' followed by their domain name, so should Universal Resource Locators (URLs) within the WWW information service itself. Often, users may try to guess the particular address of some information based on the address of some similar information. For instance, if Office A has the homepage, *http://www.host.gov/officeA.html*, and a user is looking for office B's homepage, a logical assumption would be to type in the URL, *http://www.host.gov/officeB.html* as a shortcut instead of navigating in the WWW. If the service is not consistent the user may not be able to find office B by using this shortcut.

**Standard Symbolologies** - Although graphics are discussed in more detail later on in this paper, it is important to note that there should be a set of standard symbolologies. Standardized graphics will allow users to quickly associate particular information being available. For instance, an envelope icon can be used to inform the user that there is a point of contact's e-mail address associated with this information. The user, upon seeing the envelope icon again in the system, would identify it with an e-mail address being available. However, if the WWW information service interchangeably uses icons for a postage stamp and a mailbox, in addition to the envelope, the implementation has taken time away from the user to retrieve information and replaced it with having to take time learning what these other icons represent.

**Multiple Views** - Depending on the service's intended audience, many times multiple views of the information must be established. Only in the narrowest of audiences would this not be a requirement. A good example is someone internal to the agency or in another government agency looking at the information in the agency's WWW information service. To someone inside, office symbols and government acronyms may make perfect sense and allow for easy navigation. However, a user unfamiliar with the agency structure may find it more convenient to view the information by programs going on within the agency. This is a different view of the same information. Consideration should be given to the intended audience and information views established accordingly.

## ***Documents***

The documents that make up the content of the information service are the most important part of the information service. Without content, then there is no information service. The content of information is determined from the agency's nature of business. The preparation of the information to put into the WWW service does have its guidelines. The following are several guidelines which will aid in an organization's creating documents for a WWW information service.

**Construction** - The worst scenario a user can come across when using an agency's WWW information service is seeing an "Under Construction" sign. Too many developers rush to start up their WWW information service before they have any meaningful information in the system. Interested users who learn of the new service will flock to check out what it has to offer. When they get to the service they will often be disappointed and perhaps a little angry that they wasted their time. They may not return later when the WWW information service is more populated with information. Wait until the WWW information service has enough information for users to want to come back in the future.

**Home Page** - The World Wide Web, by definition, has no top or bottom. Users looking for information may start anywhere with any piece of information. However, there is often a "front door", or as it is commonly known a home page, for an organization's information services that users are first directed to. The home page should be attractive and fast loading if the rest of the information service is to be of any



consequence. Because it is often the first impression of the service or the agency itself, it must be given the utmost attention. There should be links to general areas of the WWW information service, but not links to every piece of information from the home page. Although, information providers may tend to equate their information being linked on the home page as an indicator of importance, web policy should make clear that it is detrimental to the service to have too many links on the home page.

**Title** - Titles of documents are very important. Often, search engines use the document's title to classify it in the search engine's database. Programs that generate HTML code from more traditional formats of information often just use the name of the document as the title. For example, if you have a document that it is in Microsoft Word document format called "*document1*", which describes 3-dimensional optical memory computer chips, then when it is converted, the title of the document will be "*document1*" instead of something like "*3-dimensional Optical Memory*". Generic titles like "*Home Page*", "*Test*" and "*Help*" should also be passed up for descriptive titles that tell more about the content of the document.

**Spelling** - With the abundance of spell-checking software available and more often than not built into programs that generate documents, there is no excuse for misspelled words. Misspellings are simple mistakes to correct and are obvious to information service users.

**Stamping** - Information appearing by itself is sometimes not enough for users. Documents should be stamped with a date as to when it was created, last updated, and possibly expires. Another stamp that documents should have is a notation as to what person or office is responsible for creating or maintaining the document. Stamping can be as simple as a date or point of contact discreetly located at the bottom of the document. Stamping will lend credibility to the information because users can then determine its source and timeliness.

**Linking** - The WWW can often be confusing to navigate as it is already full of bad hyperlinks that are outdated and pointing to information and services that no longer exist. Do not link the documents to other documents that do not exist. If the intent is to construct these documents later, then link to them later as well. Users will think the link is incorrect or the service is down.

**Excessive Comments** - HTML allows for comments to be placed in documents that the browser software will not display but can be viewed if the document's HTML source is looked at. While comments may be nice for WWW information service maintenance, minimizing the amount inserted into documents should be practiced. After all, the comment is not intended to be viewed by the user, so why waste time and system resources sending it to the user along with the information that they are really interested in?

## **Graphics**

Graphics are one of the reason's that the World Wide Web became so popular. It is aesthetically attractive to view text and images instead of binary 1s and 0s on the screen as a user retrieves information. The problem is that graphics can also consume a high level of system resources and actually detract from the effectiveness of the information service. Guidelines for graphics in an information system are addressed in the topics to follow.

**Image Size** - The size of images should be kept small to take into consideration network bandwidth limitations. Large images take a longer time to download from the server to the client and will give users more than enough of a reason for aborting out of the transaction. Again, consider the intended audience. The users may be dialing in with modem connections from the other side of the country or world. Do not assume the transfer speeds will be comparable to the ones achieved on the organization's local area network. Graphic images need to be kept small and uncomplicated.

**Graphic Alternatives** - Client software often comes with the option to turn off graphic images to compensate for slow information transfer speeds. To prevent users from losing important information, text alternatives to the image should be incorporated. This is critical for images used for navigation within the service.

**Standard Graphics** - As mentioned before, standard symbologies should be used for information that appears more than once to allow users to focus on the information itself and not the relearning of a symbol. Another reason to use standard graphical representations is that many browser clients cache

images and information, making a disk retrieval of the “standard” icon much faster than the network download of another graphic.

**Discretion in Usage** - Finally, do not add a graphic because “it looks neat” or because “it is available”.

Graphics should add some value to the information that they are embedded within.

## ***Features***

During the relatively short existence of the World Wide Web, many developers have implemented features to their WWW information services that have proved popular for aiding users in obtaining information.

The reason these features still exist is because they are effective. Besides the home page (discussed earlier), these features should be implemented as standard components in the design of the agency’s web site.

**What’s New? Page** - Out of all the standard features of the WWW information services, the “What’s New? Page” is by far the most common. It is simply a document that offers quick links to information that has been recently put into the WWW information service. Accompanying each link is often a concise description as to what the link has to offer and a date as to when the information was incorporated into the system. “What’s New? Pages” are important because users will not spend the time to browse an entire WWW service to find new or updated information, therefore it needs to be highlighted somewhere. The page is often a gauge to the user as to how much activity is going on within an agency and its WWW information service. An agency’s “What’s New? Page” with its last entry over a month old is a bad advertisement for the agency. Entries should appear daily, if feasible, on the “What’s New? Page”. The “What’s New? Page” should be accessible directly from the home page.

**Coming Soon Page** - Not as common as the “What’s New? Page”, but still important to keep users coming back, is the “Coming Soon Page”. This page highlights information that is going to be incorporated into the WWW information service in the near future.

**Index Page** - Just as readers would turn to the index of a book to quickly find the location of some information, users should have an option to view an index of information within the WWW information

service. Indexes are often arranged alphabetically but can be arranged any way which is meaningful to the information and the user audience. For example, information can be arranged by the office that provides it or by the type or category of the information. Users often turn to indexes when they are not having any success in navigating to the information that they are looking for or to get a feel for the content of the information service.

**Site Map Page** - Site maps are also quite common. Not to be confused with a geographical map of the location of the organization, site maps pertain to the information contained within the actual information system. Site maps are used for a quick navigation means and also provide all the information available in a WWW information service. Site maps differ from indexes in that they are often structured exactly as the WWW information service itself, and are not as detailed to the level that indexes are. Site maps are usually graphical and are used for portraying the hierarchy of information.

**Search Page** - Search pages are often the front end to a database or search engine which has captured all or part of the WWW information service's information. Users may type in keywords on a form on the Search Page to submit to the search engine and have it return links to the information. Search pages differ from indexes and site maps in that the engine does the navigating for the user. Having these methods available for users is important to establish in the service.

## ***New Technologies***

Be wary of new technologies. There are new ones popping up everyday on the World Wide Web.

Recent examples include: Java, Virtual Reality Modeling Language (VRML), and new HTML tags like FRAMES. Do not rush to convert the WWW information service to, or support, these technologies.

Often a new technology goes through dozens of iterations before becoming an industry standard (if it becomes one at all!). Also the newer the technology is, the fewer number of users that can probably take advantage of it. The best approach would be to build additional views of the information that incorporate the new technology and monitor how well it is being received by users, as well as the industry, before investing the WWW information service too deeply into it.

## MAINTENANCE

Obviously, the WWW information service must be maintained. If the service is not maintained, the information will just stagnate along with the usefulness of the service. There are examples in every organization of individuals or offices who hastily put up their WWW and then realized they haven't the time or desire to maintain it. Consequently, the information service just sits on the network, frozen in time, waiting to become an embarrassment to the organization or a security hole. The maintenance cycle is where the real work effort begins.

There are two levels to maintenance of the information service. The first level is at a system level. The hardware must be kept in an operational state. The connectivity to the network must be up. The software must be updated and patched. If there is a need to terminate the information service while maintenance is being performed, the maintenance work should be scheduled to non-peak user access times. The impact of the scheduled maintenance should also be brought to the attention of the users as far in advance as possible, so that they may change their schedule for using the service accordingly. This maintenance is most likely performed by the system administrators and web administrators.

The second level of maintenance is at an information level. Information put into the service must be periodically reviewed to see if it is still relevant or needs to be updated or is no longer accurate and needs to be removed from the WWW information service entirely. When new information is placed on the service it must be tested to make sure that all the links, to other pieces of information, function and that it appears in the manner it was intended and meshes well with the rest of the information in the system.

This level of maintenance may be performed by any of the assigned roles, web team members, web board members, or even administrators. This assignment should be determined in the web policy of the organization which should also outline the procedures for adding, reviewing, and deleting the information.

## SUMMARY

Government agencies, like any other organization, can take advantage of the technology that the information system known as the World Wide Web provides in aiding in the dissemination of its information to the public. However, it is simply not enough for a government agency to just have a WWW information service anymore. Practically every organization, whether government or not, has one; but not all organizations have an effective WWW service for providing information. With the proper design, implementation, and maintenance the information service's effectiveness and cost savings can be realized.

A World Wide Web information service is often a way that users can view an underlying organization. In some cases, it may be their only perception of the organization. The information service must reflect the organization that is underlying it in a favorable light. To achieve this potential, an organization must be willing to make the commitment to the whole process of design, implementation, and maintenance. This implies the organization must carefully and thoughtfully design the structure that the WWW service and its information will have, implement the software and hardware in an efficient manner, and assign the appropriately trained and dedicated personnel to key roles in the day to day operation of the information service.

## REFERENCES

December, John and Randall, Neil. 1995. *The World Wide Web Unleashed* (Second Edition). Indianapolis, IN: Sams Publishing.

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Frakes, William B. and Baeza-Yates, Ricardo (editors). 1991. *Information Retrieval: Data Structures Algorithms*. Englewood Cliffs, NJ: Prentice Hall.

Roberts, Bill. "Want a Course in Site Design? Try This (If You Dare)." *WebWeek*, Vol 2. Iss. 18 (November 18, 1996): 55-56.

### World Wide Web Site References:

A great amount of information on designing and implementing web information services can be found on the Internet. These are some recommended sites to begin researching.

Document: Comprehensive Guide to Publishing on the Web  
URL address: <http://www.webcom.com/html/>

Document: Internet Sources for HTML Authors  
URL address: <http://www.vmirror.com/spike/htmldocs.html>

Document: NCSA Beginner's Guide to HTML  
URL address: <http://www.ncsa.uiuc.edu/General/Internet/WWW/HTMLPrimer.html>

Document: Publishing Multimedia Material on the Internet through WWW with HTML  
URL address: <http://www.scar.utoronto.ca/homes/david/htmlcourse/htmlcourse.html>

Document: Top Ten Mistakes in Web Design  
URL address: <http://www.sun.com/960416/columns/alertbox/index.html>

Document: Web Pages That Suck  
URL address: <http://www.webpagesthatsuck.com/>

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